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A DISSERTATION ON THE PROCESS OF NATURE IN THE HEALING OF WOUNDS, &c.

Medical
Tracts

From the Author.

BRITISH MUSEUM

843

A
DISSERTATION
ON THE
PROCESS OF NATURE
IN THE FILLING UP OF CAVITIES, HEALING OF WOUNDS, AND RESTORING PARTS WHICH HAVE BEEN DESTROYED IN THE HUMAN BODY;

WHICH OBTAINED

THE PRIZE-MEDAL, GIVEN BY THE LYCEUM MEDICUM LONDINENSE,
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BY JAMES MOORE,
MEMBER OF THE SURGEON'S COMPANY OF LONDON.

Detur inoffenſæ metam tibi tangere vitæ,
Qui legis hoc, nobis non inimicus, opus. OVID.

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BRITISH MUSEUM

"IN WHAT MANNER ARE CAVITIES, WHETHER FORMED BY SUPPURATION, WOUNDS, OR OTHERWISE, FILLED UP?—WHAT ARE THE APPEARANCES OF THEIR FILLING UP PROPERLY?—IN WHAT MANNER IS THE NEW SKIN FORMED?—WHAT ARE THE SYMPTOMS OF ITS FORMING PROPERLY?—IN WHAT CASES, AND IN WHAT MANNER ARE THE PARTS, WHICH WERE DESTROYED, RESTORED?"

WHEN any accident or diſeaſe injures the human frame, it was early obſerved, that the body poſſeſſed within itſelf a power of alleviating or remedying the evil. This ſalutary diſpoſition was named by the ſchools, the Vis Medicatrix Naturæ. In conſequence of this power it happens, that whenever the ſtructure or functions of any part of the body are diſturbed, ſuch operations are immediately excited as have a tendency to reſtore the machine to its former ſtate. This looks as if ſome ſpirit of Health, ſome inviſible Hygeia were diffuſed through the body to remedy its diſorders. But though the exiſtence of ſuch an inviſible agent was ſupported by the famous Van Helmont and others, it has long been rejected as a mere chimera; and indeed it is an idea more reſembling the fiction of a poet, than the theory of a philoſopher.

But although this perſonification cannot be admitted, yet the principle of the Vis Medicatrix Naturæ is undeniable. And on no occaſion are its operations obſerved more ſtrikingly than in the filling up of cavities, in the formation of new ſkin, and in the reſtoration of parts which are deſtroyed. In theſe caſes the power of the Vis Medicatrix Naturæ is obvious; whereas in moſt others it is obſcure or doubtful.

In the conſideration of this ſubject, I ſhall follow exactly the order in which the queſtions are placed; for they are judiciouſly arranged, according to the natural ſucceſſion of events which occur. But though there are five queſtions propoſed, as theſe form three principal diviſions, by uniting the four firſt into two, I ſhall make only three ſections of the whole.

SECTION I.

"IN WHAT MANNER ARE CAVITIES, WHETHER FORMED BY SUPPURATION, WOUNDS, OR OTHERWISE, FILLED UP?—AND WHAT ARE THE APPEARANCES OF THEIR FILLING UP PROPERLY?"

NONE of the cavities, which are here ſpoken of, naturally exiſt in the human body. They are all produced by a ſolution of continuity of the ſolids, and are formed either in conſequence of ſome external injury, or internal diſeaſe. This diviſion of parts, which naturally cohere, muſt prevent or diſturb their functions. In order to alleviate or remove this inconveniency, the Vis Medicatrix Naturæ, or the natural power of the body, endeavours to fill up or obliterate ſuch cavities.

To accompliſh this purpoſe, inflammation is excited all over the internal ſurface of the cavity.

The intention of the inflammation ſeems to be, to enable the blood-veſſels to form a ſubſtance capable of uniting the oppoſite ſides of the cavity, or filling it up. This ſubſtance muſt be either living animal-matter, or ſomething capable of becoming ſo: the blood-veſſels, in their natural ſtate, are not capable of forming the new medium, it is an office not uſually required; but when it becomes neceſſary, inflammation takes place, and the blood-veſſels ſuffer a change which empowers them to perform this new function.

What particular alteration takes place in the veſſels, enabling them to form the new ſubſtance, is a circumſtance as yet unexplained. The principal change, which we are able to obſerve, is their being augmented in ſize, ſo that a vaſt number of the capillaries, which in a natural ſtate are inviſible on account of their admitting only the tranſparent parts of the blood, become during an inflamed ſtate very apparent, by their diameters being ſo much enlarged as eaſily to receive the red globules.

Inflamed veſſels ſeem likewiſe to acquire a great deal of additional ſtrength, or at leaſt they act with greater energy than formerly; for the blood is obſerved to circulate with far greater rapidity through an inflamed, than through an uninflamed part. But neither of theſe circumſtances throw much light upon the ſubject, there muſt certainly be ſome other change, beſides an increaſe of bulk and action. It ſeems moſt probable that it is the mouths of the arteries which depoſit the new ſubſtance, although they are ſo extremely minute, that we can diſcover nothing of their ſtructure even by the fineſt microſcopes.

During an inflammation there is likewiſe an effuſion of a watery fluid into the cellular membrane, or neighbouring parts; but this does not ſeem at all to aſſiſt in the extinction of the cavity; it is, probably, nothing more than an increaſed quantity of the interſticial fluid which is common upon internal ſurfaces. The lymphatics uſually abſorb this fluid as faſt as the arteries depoſit it; but when inflammation takes place, the blood-veſſels being increaſed in ſize, and the circulation going on in a more rapid manner, the interſticial fluid is effuſed faſter than the abſorbents can take it up, of courſe there muſt be an accumulation.

Beſides the local appearances which occur in inflammation, the general conſtitution is affected with febrile ſymptoms, which are termed, "The ſymptomatic fever."

The inflammation is uſually conſidered as the cauſe of this fever, and ſympathy, or ſome nervous influence, is by ſome ſuppoſed to be the intermediate agent which produces it. This hypotheſis although extremely ingenious, yet, when thoroughly examined, will not, I ſuſpect, be found juſt. In my apprehenſion it ſeems more probable, that the inflammation inſtead of being the cauſe, is the effect of the fever; or, in other words, that the fever conſiſts of certain actions which take place in the conſtitution in order to produce the inflammation.

I know that this opinion, as well as ſome others which ſhall be given afterwards, is different from what has been publiſhed, and what I have heard taught, by ſome of thoſe gentlemen who are to determine concerning the merits of this paper. Yet, as I know they are too generous to condemn an opinion merely becauſe it is different from theirs, I ſhall, without heſitation, ſet down exactly my real ſentiments.

Many reaſons could be given, if it were not improper here to enlarge upon this ſubject, to evince the impropriety of conſidering moſt of the ſymptoms of fever, as ſympathetic with, or cauſed by the inflammation. I ſhall only mention in particular, that the fever is always antecedent to the inflammation; and it is impoſſible to ſuppoſe that an effect ſhould precede its cauſe. Beſides, it appears very improbable, that ſympathy ſhould in every inſtance of conſiderable inflammation produce a ſet of ſymptoms which are frequently dangerous, and ſometimes fatal.

But the ſuppoſition that the fever is the cauſe, not the effect of the inflammation, is not embarraſſed with the ſame difficulties. For when a ſolution of continuity of any of the parts of the body has occurred, it becomes requiſite to unite this breach in the ſolids; the divided parts muſt therefore inflame; and in order to produce this inflammation, certain actions take place in the conſtitution. A ſpaſm ſeizes the capillaries on the ſurface of the body, the contraction of the heart and veſſels are increaſed and quickened, an unuſual heat, and the other ſymptoms of fever follow. By theſe extraordinary conſtitutional actions, and by ſome local ones, inflammation is generated.

The ſymptomatic fever is, therefore, the conſtitutional agent or cauſe which produces inflammation.

It is no objection to this opinion, that a fever frequently occurs without inflammation. For a fever alone cannot occaſion inflammation, without the local action likewiſe.

The febrile ſymptoms are not only requiſite to form, but to keep up a violent inflammation; and as ſoon as the fever abates, the inflammation decreaſes. However, the inflammation does not always diſappear entirely with the fever, for the local action can go on of itſelf, although with leſs violence, after the fever has ceaſed.

The ſymptomatic fever is, in general, proportioned to the extent and violence of the inflammation; ſo that where the inflammation is very inconſiderable, or very languid, there is either no fever at all, or ſo little that it cannot be perceived.

But an higher fever, or a more powerful action in the conſtitution, ſeems requiſite to produce inflammation in tendinous and ligamentous parts, than in the more vaſcular parts.

Although I cannot admit that the fever originally is occaſioned by the inflammation, yet I make no doubt but that after a part has inflamed, the pain and other circumſtances increaſe the fever. For pain alone is capable of producing many of the ſymptoms of fever. And perhaps no better explanation can be given of this circumſtance, and of ſome others, than by ſaying they are produced by ſympathy.

There are two remarkable ſtages or kinds of inflammation by which cavities are filled up; although the circumſtances hitherto mentioned are common to both. The one kind has been very properly named, "The adheſive inflammation," as an adheſive ſubſtance is formed during it; and the other, which is attended with the formation of pus, is named, "The ſuppurative inflammation."

As we know nothing of the mechanical ſtructure of the mouths of the arteries, either in an inflamed or in an uninflamed ſtate, it is vain to expect that any explanation can be given of the exact particulars which occaſion the different effects in theſe two kinds of inflammation. Both of them, however, have the effect of obliterating cavities; but as they accompliſh this by very different means, it is neceſſary to treat them ſeparately.

"OF THE FILLING UP OF CAVITIES BY THE ADHESIVE INFLAMMATION."

WHEN a cavity is affected with this inflammation, the blood-veſſels enlarge, and the circulation is conducted with increaſed velocity. There forms, ſoon after, upon all the inflamed ſurfaces, a buff coloured ſubſtance, like a new membrane.

This ſubſtance, when firſt thrown out, is ſoft in its texture; but, as it is frequently found adhering to the internal ſurfaces of inflamed veins, it is either at no period liquid, or elſe it is of a very tenacious nature, otherwiſe it would be waſhed away by the current of blood.

The quantity of this matter is not very great, it ſeldom exceeds in thickneſs, the eighth or fourth part of an inch. In colour and appearance it ſtrongly reſembles the coagulable lymph of the blood when freed from the red globules; and, without doubt, it conſiſts principally, if not altogether, of this lymph.

When the internal parts of a cavity are lined with this tenacious ſubſtance, if the oppoſite ſurfaces are in contact, they adhere together and obliterate the cavity. This adheſive matter, which is uſually named, the inflammatory exſudation, is at firſt unorganized, and forms a very ſlight union. But it does not continue long in that ſituation, for blood-veſſels ſoon ſprout into it from all the inflamed ſurfaces, and branch through its whole ſubſtance. It is in this manner that cavities are obliterated by the adheſive inflammation; which, rather than a filling up of cavities, might more properly be denominated, a growing together of their internal ſurfaces.

As the exſudation is not very great, it is obvious that a cavity cannot be obliterated by it, except the oppoſite ſides are nearly in contact. But when blood intervenes it forms no impediment, but rather aſſiſts in the extintion of the cavity.

This is a very curious circumſtance. When blood is extravaſated in a part of the body free from inflammation, it is uſually abſorbed; and ſo completely ſo, as to leave no trace behind. But when blood is extravaſated into a cavity where the adheſive inflammation has either already taken place, or where it takes place ſoon after, it is by no means wholly removed. For, after coagulating, it is ſurrounded on all ſides by the inflammatory exſudation; blood-veſſels begin, in a little time, to ſhoot into the exſudation, and they likewiſe paſs into the coagulated blood, and branch through every part of it. Theſe veſſels become more and more numerous; the red globules, and ſuperfluous parts of the blood, are by degrees abſorbed, and at length the coagulated maſs is changed into an organized piece of living fleſh.

This extraordinary fact was completely proved and demonſtrated by injection, many years ago, by Mr. John Hunter.

It is not neceſſary for me to enter here into the controverſy, Whether the blood does, or does not, poſſeſs the living principle? This is a ſubject which has of late been very much canvaſſed, and the circumſtance juſt mentioned, of the converſion of the blood into living fleſh, is given as a ſtrong proof of its poſſeſſing this property. If the blood does not poſſeſs the vital powers when circulating in the body, and when firſt extravaſated, it is at leaſt an excellent medium for the blood-veſſels to branch into, and it then acquires theſe powers. It is unimportant to my preſent purpoſe, at what period this takes place. Whether the food receives the principle of life during chylification or ſanguification; or whether it is beſtowed upon the blood after coagulation? There may be the ſame diſpute, likewiſe, Whether the adheſive exſudation poſſeſſes the vital powers before or after its organization? But in whatever manner theſe points are determined, certain it is, that this property is acquired ſomewhere; for the coagulated blood and inflammatory exſudation become as much an organized living part, as any other in the body.

Cavities then are obliterated or filled up during the adheſive inflammation, either by the interpoſition of the inflammatory exſudation alone, or by that exſudation and coagulated blood.

If this explanation is juſt, no ſuch thing can ever occur as the union of divided parts by inoſculation; a mode of healing which was once taught. That is to ſay, it never happens that the cut veſſels of two wounded ſurfaces, when brought into contact, unite and inoſculate in ſuch a manner, that the blood circulates acroſs the wound by the ſame veſſels as formerly. This can never take place, for the blood-veſſels of a wounded part contract, and are plugged up by coagula of blood. And as blood, when coagulated, never to our knowledge becomes again fluid, the cut veſſels will remain obſtructed and obliterated for ever. In order therefore to unite the ſolution of continuity, and carry on the circulation acroſs the wound, inflammation comes upon both ſurfaces, and the inflammatory exſudation is formed.

In all wounds healed by the adheſive inflammation, or by the firſt intention as it is uſually named, there are, therefore, interpoſed between the wounded ſurfaces, two layers of the inflammatory exſudation; and moſt commonly two layers likewiſe of extravaſated blood. Theſe layers are, indeed, ſometimes extremely thin; and they acquire in a ſhort time blood-veſſels, lymphatics, and nerves, and become an excellent bond of union between the divided parts.

As coagulated blood and the inflammatory exſudation conſtitute the medium through which the union by the firſt intention is accompliſhed, it muſt follow, that if either of theſe ſubſtances loſe the quality of being a proper medium, no union can take place.

Whether the blood is ever rendered by diſeaſe unfit for uniting divided parts, is a doubtful point: but even in a healthful ſtate, it certainly loſes this property when freely expoſed to air.

When blood is extravaſated into any of the internal parts of the body, except the lungs and primæ viæ, if the integuments remain entire, there being no acceſs to the air, the blood can receive no injury from it. But in all wounds and compound fractures, the extravaſated blood is neceſſarily expoſed, and liable to any impreſſion that air is capable of making. If the expoſure is only for a ſhort time, no bad effects ſeem to follow; but if the expoſure is laſting, the blood putrefies, and conſequently the union of the wound by this medium fails.

Thoſe phyſiologiſts, who maintain that the blood is poſſeſſed of the vital principle, explain this fact by ſaying, that the expoſure to air firſt deprives the blood of the powers of life, and it then putrefies like other dead matter. In the ſame manner, as the expoſure of a tendon, or any other ſimilar part where the vital principle is weak, is apt to occaſion ſloughing.

Thoſe perſons, on the other hand, who do not believe in the living principle of the blood, will ſay, that it putrefies in theſe caſes, ſimply becauſe it is expoſed to a very conſiderable degree of heat, and to the free acceſs of air; circumſtances favourable for that proceſs.

In ſuch ſpeculative queſtions, which admit not of poſitive but only of probable proofs, men of abilities can bring ingenious arguments on both ſides. But in whatever manner the air acts, it is evident that it has a ſtrong tendency to deprive the blood of the power of being a proper medium for the union of parts by the firſt intention. In wounds and compound fractures it is therefore requiſite, in order to accompliſh this union, to exclude air by approaching the lips of the wound together and covering them. Sticking plaſter, lint, and a bandage, which are the means commonly employed, accompliſh this purpoſe very completely. For the lips of the wound are brought contiguous, and the bandage or lint, by abſorbing ſome of the blood, and growing hard and dry, forms a cake impenetrable to the air.

But although no large wound ever heals by the firſt intention, if left to itſelf, yet very ſlight cuts and ſcratches uſually do; for ſome of the blood which lies upon the hurt, dries, hardens, and prevents the acceſs of air to the reſt.

The inflammatory exſudation is the ſecond ſubſtance by which an union by the firſt intention is accompliſhed. The formation of which is abſolutely requiſite for the extinction of cavities; whereas the blood is not eſſentially neceſſary, although it cauſes no impediment.

This exſudation is formed by the arteries when they are affected by the adheſive inflammation; and the filling up of a cavity by the firſt intention, depends upon the exſudation being formed on the whole divided ſurfaces, of a proper quantity and quality. As this exſudation is formed in conſequence of inflammation, the appearance of a cavity being properly filled up by the adheſive inflammation, muſt therefore be denoted by ſuch ſymptoms as demonſtrate a due degree of inflammation.

This is a different poſition from the commonly received notion, that there is a better chance of a wound healing by the firſt intention, in proportion as the inflammation is ſlight. But if this were true, it would eſtabliſh what daily experience contradicts; namely, that a wound could heal better in a languid, feeble, and diſeaſed body, than in a vigorous, ſtrong, and healthy one: whereas the fact is, that inflammation is uſually leſs violent in the weak than in the ſtrong; and wounds generally heal better in the ſtrong than in the weak.

Inflammation is the proceſs by which the Vis Medicatrix Naturæ fills up cavities. The Vis Medicatrix Naturæ acts moſt effectually in the ſtrong, and in the healthy, during the prime of manhood. It is, therefore, that degree of inflammation which takes place in theſe moſt perfect bodies, which tends moſt effectually to fill up and obliterate cavities. In the ſanguineous temperament, the inflammation is apt to be too violent; in the phlegmatic, to be too languid. But the exact and due degree of inflammation takes place not in any peculiar temperament, but in thoſe more happily conſtructed bodies, where no individual temperament prevails, but where there is a fortunate mixture of them all. If the inflammation is too languid, the exſudation is not thrown out in ſufficient quantity; or it is of a bad quality, and no union can be produced. And if it is too violent, the exceſſive action of the veſſels is likewiſe inconſiſtent with the union of the ſides of the cavity.

This opinion which I have advanced, that the obliteration of cavities, and healing of wounds by the adheſive inflammation, ſometimes fails from the parts inflaming too ſlightly, may appear ſingular, and perhaps unfounded; yet I have been led into the opinion, not from any theoretical idea, but from what I have frequently obſerved in the courſe of my practice.

A perſon receives a fleſh-wound with a cutting inſtrument, and the lips of the ſore are brought and retained in contact. If the adheſive inflammation is extremely languid, the inflammatory exſudation will either be of a bad kind, or ſo ſmall in quantity, as not to be able to form the union. This mode of obliterating the cavity of the wound failing, Nature has recourſe to the next; namely, ſuppuration. So that the adheſive inflammation being too ſlight, becomes the indirect cauſe of the ſuppurative taking place. Theſe caſes happen moſt frequently in the debilitated, in the phlegmatic, and aged.

When we attempt to heal a wound by the firſt intention in ſuch weakened bodies, it frequently happens that, inſtead of a briſk inflammation coming on in a few hours, there are hardly any ſymptoms of inflammation for ſome days; but at laſt it gradually comes on, then runs too high, and terminates in a plentiful ſuppuration of the whole wounded ſurfaces. Inſtead of imputing this ſuppuration to the adheſive inflammation being at firſt too languid, and the neceſſity Nature was in of exciting ſuppuration in order to obliterate the cavity of the wound, it is generally imputed to the direct oppoſite cauſe, a too violent inflammation.

I hope, however, that the fallacy of this appears from what has been ſaid; and that it will be allowed that the filling up of cavities properly by the adheſive inflammation, muſt be produced by a due degree of that inflammation.

What then are the ſymptoms of a due degree of the adheſive inflammation?

The ſymptoms of the adheſive inflammation are exactly the ſame with thoſe of the phlegmonous, only uſually milder than when ſuppuration occurs. It is impoſſible by language to diſcriminate exactly the different ſhades of inflammation. All that can be done is to give a general account; and the experienced alone can determine in particular caſes, whether the inflammation is in the proper degree for uniting cavities, or not.

When a phlegmon is coming on, the conſtitution is firſt affected with the ardent or inflammatory fever. The local ſymptoms which follow, are, throbbing, pain, heat, ſwelling, tenſion, hardneſs and redneſs.

Thoſe ſymptoms are in proportion to the extent and violence of the inflammation; and to the importance and nature of the parts affected.

In a ſlight wound of ſuperficial parts, where the adheſive inflammation is of a juſt degree, the conſtitutional ſymptoms are not perceptible, and the local ones are very trifling.

In a large wound, or other ſevere injury, the ſymptoms are proportionably more conſiderable. Some fever is requiſite to uſher in a proper degree of inflammation. The pulſe is more frequent and hard than uſual, the ſkin hotter, the tongue whiter, and the thirſt greater; there is likewiſe a ſlight degree of heat, ſwelling, and pain in the part.

Theſe ſymptoms prove that a degree of inflammation ſufficient for obliterating the cavity has taken place; and yet they are not ſo violent as to render ſuppuration at all probable. But the moſt certain mark of this being the caſe, is, when the above ſymptoms come on quickly, and ſoon ſubſide. When the adheſive inflammation comes on moſt favourably, it is at the height in twelve or twenty-four hours, at which time the inflammatory exſudation is uſually formed, and the ſymptoms of inflammation abate immediately after. But if the ſymptoms continue increaſing after that period, particularly if they augment after the ſecond or third day, there is then great reaſon to believe that ſuppuration is coming on.

The union of cavities, by the adheſive inflammation, much more frequently fails from too violent, than from too languid a ſtate of inflammation. And the leſs the wounded parts are injured by being bruiſed or lacerated, there is the better chance of the union by the adheſive inflammation.

Therefore when a wound is made by a ſharp cutting inſtrument, it will be much more likely to heal by the firſt intention, than when it is made by a blunt one. And when parts are bruiſed or lacerated much, their tone is ſo much injured, that they are incapable of going through the adheſive inflammation properly, and the ſymptoms become ſo violent, that ſuppuration or gangrene takes place.

When the injury is ſuch as to occaſion the death of any of the parts, the extinction of the cavity by the adheſive inflammation becomes impoſſible: for the dead parts putrefy, and ulceration comes on in order to ſeparate them from the living; which is a proceſs incompatible with the union by adheſion.

The interpoſition of foreign bodies likewiſe muſt prevent the adheſion of the parts between which they lie; and ſuppuration uſually occurs in order to throw out the foreign body. But it ſometimes happens that bullets, and other ſubſtances which have penetrated deeply, do not excite ſuppuration, and remain quietly in the body, ſurrounded by a coat of the adheſive exſudation.

It is not uncommon for the deep ſeated parts in wounds to unite by the firſt intention, and the ſkin and ſuperficial to ſuppurate. This ſeems to be occaſioned by the oppoſite edges of the ſuperficial parts being more diſtant; and to the blood on the ſurface, from its expoſure to air, loſing the power of being a proper medium for union and putrefying; while the blood in the deep ſeated parts which is not expoſed, becomes organized. It likewiſe ſometimes, though rarely, happens, that the wounded ſkin heals, while the deep parts ſuppurate. This is owing to the latter being more lacerated or injured by the wounding inſtrument, and the inflammation conſequently is more violent. When this occurs, the cavity cannot be filled up by the adheſive inflammation, another mode becomes neceſſary; which ſhall next be conſidered.

"OF THE FILLING UP OF CAVITIES BY THE SUPPURATIVE INFLAMMATION."

THERE is a great variety of circumſtances in which thoſe cavities, that have been treated of, cannot be filled up by the adheſive inflammation. On which account the body is endowed with the power of accompliſhing this purpoſe by another means, which is, ſuppuration.

This proceſs takes place after the inflammation has failed to obliterate the cavity, provided the affection is not of ſo violent a nature as to occaſion gangrene.

In cavities formed by wounds or other injuries, the circumſtances which occaſion a failure of the union by the adheſive inflammation, have been already mentioned. Thoſe which have been formed by ſuppuration muſt, of courſe, be filled up by the ſuppurative inflammation, as the adheſive has terminated before the cavity is formed.

The eſſential diſtinction between the two kinds is, that in the ſuppurative there is ſecreted a fluid ſubſtance, named pus; and in the adheſive there is no ſuch ſecretion.

Before ſuppuration takes place in a cavity, it is preceded by the adheſive ſtage, by which the inflammatory exſudation having been thrown out, all the cells of the reticular membrane are united together, and the pus, when formed, is confined to the cavity.* If it was not for this circumſtance, the matter would diffuſe itſelf among the cellular membrane, which actually happens in the eryſipelas: for in that diſeaſe there is no exſudation of the adheſive ſubſtance; and if pus is formed, it inſinuates itſelf among all the neighbouring parts, and gives to the touch a ſenſation ſimilar to that felt by preſſing a quagmire. In this caſe, however, before the cavity can be filled up, the inflammatory exſudation muſt be thrown out, and then it becomes exactly like a common ſuppuration.

When a phlegmon affects a cavity, the inflammation (as has been mentioned) is at firſt of the adheſive kind; and ſome degree of fever occurs before the inflammatory exſudation is formed. The febrile ſymptoms requiſite for that purpoſe are uſually, however, inconſiderable, in compariſon with thoſe which are neceſſary to produce ſuppuration; for this proceſs demands a much greater effort of the conſtitution. The firſt attack of fever is, therefore, uſually moderate; but if ſuppuration is coming on, inſtead of the febrile ſymptoms remitting when the exſudation is formed, they increaſe greatly. The pulſe becomes more hard and frequent; pains are felt in the head and loins, and the body becomes very hot. Rigours or cold fits alſo ſometimes take place; which are particularly apt to occur immediately previous to the formation of matter.

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* Suppurations of the ſurfaces of mucus membranes are not preceded by the adheſive inflammation. But that is a ſubject foreign to the preſent.

Theſe ſeem to be occaſioned by a ſpaſm which affects the veſſels on the ſurface, in order to produce a more violent hot fit. For the rigours are ſoon followed by a hot ſtage; during which the action of the heart becomes violent, the ſpaſm diſappears, the veſſels of the part affected in particular enlarge in ſize, and the circulation is there conducted with great rapidity. By this great effort, both of the conſtitution and of the part, ſuppuration takes place, and the fever gradually ſubſides.

The conſtitutional affection occaſioning ſuppuration in no reſpect differs from the ordinary ſymptoms of fever; but the local changes are of a complicated nature, and ſhall now be mentioned.

There are two diſtinct ſituations in which ſuppuration takes place. In the firſt, there is either an external opening, or a communication with ſome of the outlets of the body, by which the pus flows off and is evacuated. In the ſecond, there is no opening whatever, and the matter is confined in a ciſt formed by the adheſive exſudation. This laſt kind is named an abſceſs.

I ſhall, firſt, deſcribe that affection, where there is an opening; and, laſtly, the abſceſs.

As there is a breach of the integuments in all wounds and compound fractures; whenever a cavity occaſioned by one of theſe accidents ſuppurates, the affection is neceſſarily of the firſt kind; and theſe injuries always do ſuppurate when left to themſelves, except the wound is very ſmall. The progreſs by which theſe cavities are filled up by the ſuppurative inflammation, is as follows.

The whole cavity is, in the firſt place, filled with blood; and when the hæmorrhage ſtops, the blood coagulates.

The adheſive inflammation then comes on, with all its ſymptoms; but theſe, inſtead of decreaſing in a few hours, become more and more violent. Heat, pain, and throbbing, are felt in the wounded part, which becomes red, tenſe and ſwollen. The lips of the wound, which at firſt retract a little from each other by the natural elaſticity and contraction of the parts, become ſomewhat inverted and farther ſeparated by the ſwelling. In ſuppurating wounds the blood does not become an organized body, as in thoſe which heal by the firſt intention; but, on the contrary, it quickly diſſolves down into putrefaction: this renders the ſmell, at firſt, very offenſive.

The diſcharge from the wound during this period is, principally, the putrid ſerum and craſſamentum; but this is ſoon mixed with a thin ſerous ſecretion formed by the wounded ſurfaces. This diſcharge, by degrees, acquires a whiter colour and thicker conſiſtence; and about the fourth or fifth day, pure pus is diſcharged, and the inflammation abates.

In ſuppurating wounds, ſomething more is requiſite than what takes place in thoſe which are healed by the firſt intention. For there is always a conſiderable gap by the oppoſite parts retracting from each other. This gap is, of courſe, greater in wounds with loſs of ſubſtance, than in others; but it occurs in all. In order to fill up this vacancy, a growth of new fleſh is neceſſary, and accordingly there ſprouts up a new kind of ſubſtance, which is named granulations, from all the inflamed ſurfaces.

This ſubſtance is of a florid red colour, it ariſes with ſmall irregular round points, ſomething like little grains, (hence the name) or rather reſembling the head of a cauliflower.

The ſurfaces of the granulations are moiſt by their conſtantly ſecreting pus; and they are ſo tender that they bleed if touched a little roughly. This delicate production ſprings up in a very irregular manner from the whole ſuppurating ſurfaces; in ſome parts it ſprouts up exuberantly, ſending forth pyramids and columns; while in others it goes on very ſlowly.

In general the principal growth is from the bottom and deeper parts of the wound; very little ariſing from the ſuperficial.

When two granulations come in contact, they adhere and grow together. In this manner they increaſe and unite, until the whole cavity of the wound is filled with them as high as the ſkin.

This new fleſh is of the ſame nature and appearance, from whatever part of the body it ſprings; even that which ariſes from bones, differs in no reſpect from that which grows from the ſofteſt parts. When granulations are cut, they appear an uniform maſs without fibres running in any particular direction. They ſeem principally compoſed of blood-veſſels; and as the blood circulating in them is nearly in contact with the air, it acquires the florid red colour, which good blood always receives when in that ſituation. There are a great many lymphatics in granulations, which is proved by ſalivations having been induced by dreſſing ſores with mercurial applications. Nerves likewiſe enter into their compoſition, as is evident from their ſenſibility; and beſides this congeries of veſſels and nerves there is, probably, a connecting ſubſtance uniting all theſe parts together.

Such is the nature of the new fleſh which ariſes to fill up a ſuppurating cavity, and to unite the ſolution of continuity. But this ſubſtance does not begin to ſpring up for the firſt three or four days. During that period the fever is high, there is a great deal of redneſs, hardneſs and tenſion in all the parts contiguous to the wound, and the pain and heat are conſiderable.

Theſe ſymptoms gradually diminiſh. At length all pain and tenſion diſappear, and the redneſs is confined to the ſurface of the ſore, and leſs than a quarter of an inch around it. The diſcharge, likewiſe, alters materially. It is at firſt of a thin conſiſtence, of a ſerous colour and offenſive ſmell; and by degrees it becomes thick and viſcid, of a yellowiſh or white colour, and nearly inodorous.

The ſore then granulates, and in proportion as the granulations ariſe, the diſcharge leſſens in quantity, and becomes thicker in conſiſtence. Whilſt the wound is granulating, the edges of the ſore approach to each other, which diminiſhes its width.

It ſeems extraordinary, that the wounded parts, contrary to their natural elaſticity, ſhould approach each other in this manner. Some have accounted for this fact by ſuppoſing, that the granulations are endowed with muſcular powers, and that Nature had contrived this method of leſſening wounds, and preventing large cicatrices. But if wounds are narrowly obſerved, it will be perceived that there is no neceſſity for beſtowing theſe extraordinary properties upon granulations; and that this phenomenon is ſimply owing to the abatement of the ſwelling. For when a wound is firſt received, the elaſtic and contractile powers of the parts occaſion a retraction of the wounded edges to a certain diſtance. When the ſwelling comes on, there is a ſtill farther ſeparation; for the internal parts are increaſed in bulk by the ſwelling, conſequently the ſkin cannot cover ſo much of them as before; and the lips of the ſore are often a little inverted; this occaſions the wound to gape very wide. But when the ſwelling abates, and the inverſion of the lips of the wound diſappears, the ſore muſt, unavoidably, decreaſe in ſize. Beſides the abatement of the ſwelling, in conſiderable wounds there is always ſome degree of waſting of the neighbouring parts, the ſkin is therefore relaxed, and enabled to cover more than formerly. From this it happens that the edges of the wound collapſe over the ſore, and give the ſame appearance as if they were contracted.

Thus we have endeavoured to explain in what manner the cavities of wounds are filled up by the ſuppurative inflammation.

As there are ſome material differences in the mode by which the cavities of abſceſſes, or collections of matter which have no communication externally, are obliterated, we ſhall next treat of them.

In theſe caſes, previous to the formation of the cavity, the ſuppurative inflammation has taken place with all its ſymptoms. The pus is depoſited in a vacuity formed by an abſorption of ſome of the ſolids, and lined with the adheſive exſudation. When the pus is fully ſecreted, the fever uſually abates or diſappears, together with the inflammatory ſymptoms. This is not, however, always the caſe; for it ſometimes happens that the inflammatory ſymptoms continue augmenting until the matter is diſcharged. This is particularly apt to occur, when the pus is confined by bones, faſciæ, or other unyielding parts.

In other inſtances, after matter is fully formed, the abſceſs appears a ſoft yielding tumor, accompanied with little or no fever, pain, or uneaſineſs.

There are two ways in which the cavities of abſceſſes are obliterated.

In the one, the pus is abſorbed; and in the other, an opening is formed, and it is evacuated.

The firſt is by far the moſt agreeable mode, as it occaſions no pain, no breach of the ſkin, and uſually a more ſpeedy cure.

It is probable, that in every abſceſs the lymphatics abſorb a little. But as the arteries generally ſecrete pus faſter than the lymphatics abſorb it, it rarely happens that collections of matter are diſperſed or removed by abſorption. This ſometimes, however, occurs; and it is produced by the arteries ceaſing to form pus; and by an uncommon exertion in the abſorbents. When in conſequence of this the quantity of matter is diminiſhed, the cavity of the abſceſs leſſens in proportion; and when the whole pus is abſorbed, the oppoſite ſides of the cavity coming in contact, unite together like a wound by the firſt intention.

The ſymptoms of this operation going on properly are very ſimple, being only a ceſſation of the pain uſually occaſioned by the abſceſs, and a gradual diminution of the tumor.

It ſometimes happens that the pus of an abſceſs is partly removed in this way; and the reſt is diſcharged by an external opening. But the total diſperſion of collections of pus is a rare occurrence, eſpecially when the ſuppuration is conſiderable.

The next and moſt uſual manner in which the cavities of abſceſſes are obliterated, is by the pus being diſcharged by a natural opening proceeding from the burſting of the abſceſs.

There has been a variety of opinions reſpecting the mode by which this is effected. Some have imagined that pus is a menſtruum which diſſolves the ſolids; others, with far greater ingenuity, maintain that it is a ferment, which, by a peculiar kind of fermentation, converts the ſolids of the body into its own nature. But the opinion which ſeems to me beſt founded, and which, I believe, is now moſt generally adopted in this country, is, that the opening of abſceſſes is occaſioned by the abſorption of the ſolid parts which contain the pus.

The lymphatics are, therefore, the active powers, by which the conſtitution rids itſelf of all collections of matter. Sometimes theſe veſſels abſorb the pus, and convey it into the circulating maſs of fluids; at other times they abſorb the ſolids themſelves, forming a perforation by which the matter is poured out of the body.

The abſorption or ulceration of the ſkin is uſually attended with ſome degree of pain. When the matter of an abſceſs is firſt evacuated, its internal ſurface appears generally of a whitiſh colour; but a freſh inflammation immediately ſupervening and producing granulations, the internal ſurface aſſumes a reddiſh hue. This renewal of the inflammation is uſually not very violent, nor attended with pain; for the relief which is produced by the evacuation of the matter, and by the diſtention of the parts being removed, is ſo great and immediate, that this ſmall renewal of the inflammation is little regarded. At firſt the opening or openings, for there are frequently more than one, are ſmall, and the ſkin being relaxed by the evacuation of the pus, the oppoſite edges of the ſore are nearly in contact; but after a little time the opening enlarges. For the overdiſtended ſkin contracts to its former ſtate; and the compreſſed internal parts increaſe in bulk in conſequence of the inflammation which ſeizes them. Theſe circumſtances tend to enlarge the opening by ſeparating the edges of the ſore, and it is ſtill more enlarged by the lips of the orifice ulcerating. This permits the matter to flow freely out; granulations then ariſe from the bottom, and fill up the whole cavity as in wounds.

I cannot help here expreſſing a ſtrong diſapprobation of a practice which is far too common. I mean that of applying cauſtics to abſceſſes indiſcriminately; or laying them open with a knife from one end to the other. In particular caſes, where there are unfavourable circumſtances for healing, or danger from delay, this uſeful, though ſevere, operation ſhould be employed. But it ought by no means to be a general, far leſs an univerſal rule. For as Nature forms an opening for the healing of the abſceſs, ſhe will generally take care that it ſhall be ſufficiently large. And it ought to be the earneſt wiſh of every ſurgeon in the practice of a ſcience whoſe ſole object is relieving the miſeries incident to humanity, to accompliſh every purpoſe he has in view by the mildeſt means poſſible.

I have now deſcribed the manner in which cavities are filled up by ſuppuration. And as it was formerly ſaid, that the appearance of a due degree of the adheſive inflammation is the indication that a cavity is filling up properly by the means of that inflammation, in the ſame manner, the ſymptoms which demonſtrate a due degree of the ſuppurative inflammation are the proofs of the filling up of a cavity properly by ſuppuration. When this proceſs goes on in the moſt favourable manner, the inflammation is neither too violent nor too languid, but in that moderate and juſt degree, which attends the healing of wounds in ſtrong, youthful, and well conſtituted bodies.

The ſymptoms of inflammation are in proportion to the ſize of the cavity; it is, therefore, impoſſible to deſcribe with preciſion the appearances which occur in every individual caſe. A general idea only can be given.

Where the ſuppurating cavity is very ſmall, the conſtitutional ſymptoms are too trifling to deſerve notice. But where the cavity is of conſiderable ſize, in order to fill it up in the moſt favourable way, it is neceſſary that the ſuppuration be preceded by a moderate degree of fever. For if there are few or no feveriſh ſymptoms, no increaſe or hardneſs in the pulſe, no thirſt, head-ach, or heat, the inflammation in this caſe is certainly too ſlight, the ſuppuration too inert and languid for the end we wiſh, and the cavity will not granulate favourably; and conſequently the healing will either be tedious, or never accompliſhed.

On the other hand, if the fever runs too high, if the pulſe is extremely hard and full, the reſpiration quick, heat violent, pains in the head and joints exceſſive; and laſtly, if ſtupor and delirium come on, theſe are all indications that the cavity is not filling up properly, and even that there is danger of immediate death, or of gangrene.

For the ſpeedy and favourable healing of wounds, and the filling up of cavities, it is not only neceſſary that the fever be moderate in degree, but alſo in duration. For if it is prolonged beyond the period in which ſuppuration has fully taken place, or if the ſtrength does not gradually return, we may depend upon it that the proceſs of healing is not going on right.

During the firſt ſtages of a wound, the fever, the loſs of appetite, the diſcharge of matter, always produce debility and emaciation; but when the fever diſappears, and the appetite returns, ſtrength ſhould be in ſome degree reſtored; however, until all diſcharge of pus is ſtopped by the complete healing of the ſore, it cannot be expected that the body ſhall entirely recover its former vigour.

If inſtead of the favourable appearances, which have been mentioned, the following ſhould occur; alternate rigours and hot fits, followed by profuſe ſweats, a cough with purulent expectoration, increaſing debility and emaciation; it is then evident that a hectic fever has taken place, that the ſuppurating cavity is not filling up, but that the patient is ſinking under the malady, and his gradual diſſolution is threatened.

The local ſymptoms in favourable caſes are, a moderate inflammation, which is indicated by the heat, pain, ſwelling and redneſs of the part affected being in a ſufficient, not too violent a degree.

And theſe ſymptoms ſhould abate and gradually diſappear as ſuppuration advances. The granulations ought to be of a florid red colour, ſhooting up with irregular rounded points; and they ought to riſe as high as the level of the ſkin. But if they are of a dark red, or livid colour, or of a pale white complexion; if they are too ſmooth and regular, too ſcanty or too luxuriant; or, in ſhort, if they differ in any reſpect from the former deſcription, it evinces that the cavity is not filling up at all, or at leaſt not filling up properly.

We can alſo form a judgment of the manner in which this proceſs advances, by the nature of the matter diſcharged. If it is of a whitiſh yellow colour, of an uniform thick ropy conſiſtence, with nothing very offenſive in the ſmell, we may ſafely pronounce that all is right. But if the matter diſcharged is ſerous, bloody, extremely thin, and of an offenſive ſmell; or if it is not uniform, but curdled or cheeſy, we will form a contrary opinion.

SECTION II.

"IN WHAT MANNER IS THE NEW SKIN FORMED? AND WHAT ARE THE SYMPTOMS OF ITS FORMING PROPERLY?"

IN the firſt ſection it was ſhewn in what manner every breach of the internal parts of the body is filled up. It is requiſite in this, to explain the mode by which the ſuperficies is repaired.

As cavities are filled up in a different manner, during the adheſive and ſuppurative inflammations, there is likewiſe ſome diſtinction in the formation of cicatrices during theſe different ſtates; which ſhall, therefore, be deſcribed ſeparately.

When a wound is healed by the adheſive inflammation, the ſkin, as well as the parts more deeply ſeated, throws out the inflammatory exſudation, and the whole is united by this exſudation and extravaſated blood, as was formerly mentioned.

Upon the ſurface of the ſore a dry cruſt is formed; this conſiſts partly of the extravaſated blood, and partly of an exſudation from the wound, which after coagulating hardens by the evaporation of the watery parts. This cruſt or ſcab adheres to the lips of the wound; if it is removed it gives ſome pain; the ſore is then obſerved moiſt with a tranſparent fluid, and there generally follows an oozing of blood, ſome of the new veſſels of the uniting medium being torn. The cruſt does not become organized, but remains like dead foreign matter. Immediately under it, and on a level with the cutis, the new ſkin forms, and covers the uniting medium. This new ſkin is a fine delicate membrane; but it gradually becomes thicker and ſtronger. The cruſt, at firſt, adheres to it ſo ſtrongly that, if it is attempted to be removed, the cicatrix will be torn off with it. But when left to itſelf the cruſt becomes hard, dry and ſhrivelled; gradually looſens from the cicatrix, and then drops off. The ſcar now appears red; but ſoon acquires a brown colour, and at laſt changes to nearly the ſame appearance as the old ſkin, though rather more white and gliſtening.

When a wound or ſore heals by the ſuppurative inflammation, the cicatrix does not begin to form until the granulations have ariſen to the ſurface of the old ſkin, or nearly ſo.

When the healing is moſt favourable, the granulations ariſe exactly to the level of the ſkin; if they ſhoot much higher no cicatrix will form, until the exuberancy is removed by an internal proceſs, or by the ſurgeon's art: and if the granulations are much too low, the cicatrix likewiſe does not form. A mathematical exactneſs, however, is not required; for cicatrization generally takes place when the granulations are nearly of the ſame height, although ſtill a little higher or lower than the old ſkin.

The formation of the cicatrix begins from the edges of the old ſkin. The redneſs which exiſted during the inflamed ſtate abating, the ſwelling ſubſiding, and the edges of the ſore uniting with the riſing granulations.

The margin then acquires a bluiſh white or pearly colour, which gradually extends itſelf to the centre till the whole ſore is covered with new ſkin It ſometimes happens in broad ſores, that cicatrization takes place not only from the circumference, but likewiſe from one or two points in the centre; theſe appear like iſlands in the midſt of a ſea of granulations; they are of the ſame colour as the healing margin; and they become larger by extending in every direction. In conſequence of cicatrization going on from different central parts, it happens not unfrequently during the progreſs of healing, that one broad ſore is divided into two or three ſmaller ones; and when this happens, the cure muſt go on faſter. There is always more or leſs of a cuticular covering upon the cicatrix, which being conſtantly moiſtened by the diſcharge from the granulations, is ſoft and pulpy, and occaſions that whitiſh colour obſervable on the edges of healing ſores. I have ſometimes removed this cuticular ſubſtance, and have obſerved underneath the real new ſkin, which ſeems a very fine membrane of a red colour, the granulations ſhining through it.

When a ſuppurative ſore is nearly healed, if it is not kept moiſt by ſome application, a ſcab is apt to form in the ſame manner as in thoſe wounds which are healed by the firſt intention. This cruſt conſiſts of pus dried by the evaporation of the watery parts; the new ſkin forms under it, and it ſoon after falls off.

From the ſurface of the cicatrix there is no ſecretion; there are only the perſpirable veſſels. While it is forming it is kept moiſt by the diſcharge from the uncovered granulations; but when completely formed, the cicatrix is as dry as any other ſkin.

It appears that the new ſkin, at firſt, cannot form a good cuticle and rete-mucoſum, for there is always a ſucceſſion of ſcales falling off for ſome time; at laſt this ceaſes, and the new ſkin is covered with a good cuticle and rete-mucoſum, like other parts. The cicatrix changes ſucceſſively from a rediſh colour to a brown; and laſtly it becomes whiter, and of a more ſhining appearance than the original ſkin. This is a curious circumſtance and merits ſome attention.

The cutis, as every anatomiſt knows, is not a ſmooth poliſhed membrane, but is full of eminences, which are named papillæ. Theſe, in ſome parts of the body, run in waving rows, and form in others irregular lozenges and triangles. The rete-mucoſum and cuticle, which lie immediately over the cutis, are marked with furrows analogous to the eminences of the cutis. The cuticle is of a light colour, and ſemi-tranſparent. The rete-mucoſum is white, yellowiſh, brown or black, in men of theſe various colours. And the cutis is extremely vaſcular; the blood contained in theſe veſſels ſhines through, and gives the florid fleſhy tint to the body. The colour of the ſkin, then, depends partly upon the rete-mucoſum, and partly upon the blood which circulates in the cutis. In white men the cuticle and rete-mucoſum, which cover cicatrices, appear ſimilar to that which covers other parts; but there is a great difference in the quantity of blood which circulates in the old and new ſkin. For the new is far leſs vaſcular than the old; or, at leaſt, the greater number of its veſſels are of a much ſmaller diameter, and admit a leſſer quantity of the red globules of the blood. It happens in conſequence of this, that cicatrices are of a whiter colour than the original ſkin. In negroes, the reverſe takes place, their ſcars being generally blacker than other parts, owing to a darker rete-mucoſum forming in them upon ſcars, than upon the old ſkin.

Beſides the difference of colour, a cicatrix has a gloſſy, ſhining look, which the ſkin does not poſſeſs: this is owing to the ſcar being a ſmooth poliſhed membrane without hair, or any of thoſe papillæ which are upon the cutis; both the papillæ and hair are parts which are formed in the firſt organization of the body, and are never afterwards produced.

As ſcars are leſs vaſcular than the old ſkin, it is probable that they have fewer nerves; for blood-veſſels and nerves are generally in proportion to each other. But as nerves can hardly ever be traced to the ſurface of the body, we can only judge of their number there, by the degree of ſenſibility; and this is conſiderably weaker in cicatrices than in the old ſkin. This indeed might naturally be expected, for ſcars have no papillæ, which are ſuppoſed to be the principal ſeat of the ſenſe of feeling in the ſkin.

It is obſerved, that ſcars are generally far leſs moveable than the original ſkin; the latter being commonly attached by a looſe cellular membrane to the deep ſeated parts; whereas the ſcar forms itſelf immediately upon the granulations, and is ſo intimately connected, as to make the ſame ſubſtance with them. This is the reaſon, likewiſe, that although a ſcar is, at firſt, exactly level with the ſkin, yet after a certain period, it often is conſiderably depreſſed. For during the healing of a ſore, particularly if the diſcharge is great, the fat and neighbouring fleſh are conſiderably waſted by abſorption. But when the whole is healed, the internal parts recover their bulk, and the fat is regenerated. The ſkin being attached looſely, readily yields and accomodates itſelf to this increaſe; whereas the cicatrix adhering cloſely, and being as it were tacked down to the parts upon which it is formed, appears depreſſed.

It ſometimes happens that a cicatrix, inſtead of being depreſſed, rather projects above the ſkin, owing to the exuberancy of the granulations upon which it is formed; and very often the ſcar has an irregular unſeemly appearance, from the granulations riſing to unequal heights.

Having ſaid ſo much reſpecting the appearance and formation of the new ſkin, I ſhall now endeavour to give ſome idea of what it is.

Its appearance is ſo different from real ſkin, that although every one agrees that it is not the ſame, yet there are very different opinions with reſpect to what it really is.

Some authors aſſert that it is a diſtinct membrane; others, that it is only the cellular membrane condenſed; or, as one or two French writers have termed it, An exſiccation of the ſurface of the ſore. Mr. Bell of Edinburgh, in his excellent Syſtem of Surgery, ſays, "That a dry pellicle of a ſcarf-ſkin forms over wounds."

But it is certain that, upon every cicatrix there is both a cuticle or ſcarf-ſkin, and likewiſe a rete-mucoſum, which may be raiſed by a bliſter in the living body; or may be removed in a dead body by maceration. After theſe membranes are taken away, there is diſcovered underneath a ſmooth poliſhed ſurface, which is, properly ſpeaking, the new ſkin. If it is attempted to diſſect this from the deep ſeated parts, there is found no line of ſeparation, no diſtinction of parts, but all is uniform. The operator, therefore, if he perſiſts in his attempt, does not know whether to cut to the depth of the fourth, eighth, or tenth of an inch; the ſubſtance of the whole, except the ſmooth external ſurface, being ſimilar.

It is, therefore, a mere diſpute of words to conteſt whether there is a new membrane or not. If it is ſaid that there is one, it muſt be allowed to be ſo intimately attached to the parts upon which it is formed, that no ſeparation can be obſerved. And if there is ſaid to be no new membrane, it muſt be granted that the ſurface of the ſore loſes its extreme vaſcularity, the power or diſpoſition of ſecreting pus, and becomes ſmooth, poliſhed, and able to form a cuticle and rete-mucoſum.

The ſubſtance of the new ſkin is, then, exactly of the ſame nature with the new fleſh upon which it forms; and although it has by no means the ſame elaſticity as the old ſkin, yet it is nearly as ſtrong and able to reſiſt mechanical violence. It is, therefore, a good ſubſtitute for the other.

The difference in its appearance from the original ſkin is at firſt ſtriking; this diſſimilarity gradually leſſens with time, but never vaniſhes entirely. For as the ſcar cannot acquire the papillæ, or the ſame degree of vaſcularity with the cutis, it continues diſtinguiſhable during life; as is proved by the wound of even the fineſt lancet in bleeding.

But in ſuperficial cuts, in thoſe ſmall abſceſſes called pimples, and other ſlight ulcerations, and in the mild ſpecies of the ſmallpox, where the ſurface of the cutis only is affected, and where it is not pierced through, no laſting ſcar is left. Becauſe in theſe caſes an entire portion of new ſkin is not required, as ſome of the old remains, from which the roots of the papillæ and hair ſhooting up, the temporary ſcar diſappears and the part regains its former appearance. But when the puſtules of the ſmallpox, or other ulcerations, corrode ſo deep as to deſtroy the cutis or papillæ, the cicatrix or ſcar never diſappears; as is often cruelly exemplified in the bad ſpecies of ſmallpox. The puſtules ſometimes heal with a depreſſion or pit, as it is called; and ſometimes where no pit is left, but all is level, a gliſtening white mark remains for ever. For papillæ once deſtroyed never again ſpring up; for which reaſon the cicatrix never acquires an equal degree of vaſcularity with the original ſkin.

When a ſore heals properly, the patient's ſtrength, in as far as it has been diminiſhed by the diſcharge, is gradually reſtored as that diſcharge abates. But when very old ulcers, to which the conſtitution has become accuſtomed, and by which it is benefited, are healed, the ſtoppage of the ſalutary drain they produce, ſometimes has dangerous conſequences.

SECTION III.

" IN WHAT CASES, AND IN WHAT MANNER ARE THE PARTS, WHICH WERE DESTROYED, RESTORED ?"

THE deſtruction of a part of the body may be occaſioned by mechanical and chymical powers, by ulceration, and by mortification.

When any organ eſſential to life is deſtroyed, all animal operations ceaſe, and death muſt enſue. But when a part not abſolutely eſſential to life is deſtroyed, the body continuing to breathe, the blood to circulate, and life to go on, various efforts are made by Nature to repair the injury.

It has been a matter of much controverſy, particularly in France, Whether there ever is a reſtoration of any parts of the human body which have been deſtroyed? In the heat of the diſpute, each party have made aſſertions not confirmed by experience, and have denied facts that are.

One party inſiſts, that in wounds, abſceſſes, and ulcers, there is always a growth of fleſh of the ſame nature with that which is divided or deſtroyed. If a muſcle is cut through, or part of it deſtroyed, the new fleſh, they aſſert, becomes muſcular; if the ſame injury happens to a gland, the new ſubſtance becomes glandular; or if to a tendon, tendinous; and ſo on of all the different ſubſtances of which the body is compoſed.

It would be happy for mankind if this conſtant reſtoration took place. And perhaps the opinion was at firſt admitted, from the tendency natural to men, of eaſily believing what they wiſh to be true.

The other party is equally poſitive, that in wounds and ulcers there is no growth of new fleſh of any kind or quality whatſoever. They inſiſt that the cavities of ſores are obliterated, not by new fleſh ariſing from the bottom to the height of the ſkin, but by the parietes of the cavity ſhrinking to the depth of its bottom. And notwithſtanding that they muſt often have been obliged in their practice to oppoſe the exuberant granulations by bandages and eſcharotics, yet nothing would compel them to ſwerve from their opinion, and to truſt to their eyes. They exerted their ingenuity in proportion to the difficulties they had to encounter, and have diſplayed wonderful ſubtlety in attempting to prove, what one can hardly conceive they believed.

It would certainly be very different from the uſual proceſſes of Nature, to remedy the inconveniences reſulting from the loſs of an ounce of fleſh, by cauſing the neighbouring parts to waſte a quarter of a pound; but this is in effect what Meſſieurs Fabre and Louis have aſſerted and endeavoured to prove, by long diſſertations, in the Memoirs of the Academy of Surgery at Paris.

That there always is a growth of fleſh of the ſame nature with what is divided or deſtroyed, is certainly erroneous: that there never is any growth of any kind, is equally unfounded.

The truth then, probably, lies between thoſe two oppoſite opinions. And we ſhall endeavour to ſhew that when parts of the body are deſtroyed, different effects follow in different ſituations.

In ſome caſes the body is unable to produce any new ſubſtance to ſupply that which is loſt; and nothing more is attempted than ſimply to throw a cicatrix over the ſore.

In other caſes a new ſubſtance is formed which fills up the vacuity, but is incapable of performing the offices of the old. And laſtly, it ſometimes happens that a new ſubſtance is produced ſimilar to the old, and fit for all its offices.

I ſhall now treat of the particular ſituations in which each of theſe conſequences follow, after the deſtruction of parts of the body.

In the firſt ſection it was ſhewn that cavities which are formed by wounds, ſuppurations, or otherwiſe, were filled up by a growth of new fleſh.

Whenever any part of the body, therefore, is cut out, or deſtroyed in ſuch a manner as to leave a cavity, there is always a growth of ſome new parts to fill up the cavity, and occupy the place of that which has been loſt.

But when an extreme part is entirely removed, by whatever means, from the body, in which caſe no cavity remaining where the part formerly exiſted, no attempt whatever is made by Nature to reproduce that which is loſt.

If a hand or finger, for example, is ſtruck off, as there is no cavity left attached to the body in which that part lay, it is never regenerated. But if a piece of bone is ſawed off, or muſcular fleſh is dug out from the body, the cavity, which is neceſſarily left, will be filled up with a growth of new ſubſtance.

This new ſubſtance is uſually, however, leſs in quantity than what has been deſtroyed. If indeed the oppoſite ſides of the cavity were to remain at the ſame diſtance from each other, that they were before the part was deſtroyed; then it is probable that the new fleſh would be exactly of equal dimenſions with that which was loſt; but this never happens; for the ſides of the cavity collapſe together, and conſequently a leſs quantity of new parts is wanted to obliterate the cavity, than what formerly filled it. The quantity of new matter then depends exactly upon the diſtance which the ſides of the cavity are kept from each other. If they are brought into cloſe contact, the new parts are in ſmall quantity; but if they are ſeparated conſiderably, the growth of the fleſh is proportionably greater.

When a part is deſtroyed without leaving a cavity, it has been ſaid, that no attempt is made to reproduce it. It is not to be underſtood, however, that in theſe caſes there is, literally, no new fleſh generated; for ſome granulations always ariſe for the cicatrix to form upon. But theſe are very inconſiderable, as they do not advance higher than the plane of the ſkin; conſequently no attempt is made to reproduce the part that has been deſtroyed.

From theſe obſervations it may be known in all caſes, whether there will be a growth of new parts, or not, to fill up the place of what is loſt. But ſome inſtances, which are particularly curious, deſerve to be noticed.

When an abſceſs or ulcer forms on the flat ſurface of the tongue, and corrodes a deep cavity in its ſubſtance; if the ſore ſhould afterwards take a favourable turn and granulate, the cavity will be entirely filled up, and the tongue reſtored nearly as before.

But ſhould a part of the tip or edge of the tongue be eat away by an ulcer, or cut off by a knife, ſo as to remove or deſtroy the ſkin both on the upper and under ſurfaces, there will be no reproduction of this loſt part. For here no cavity remains where the part was, and the granulations will not ſprout above the level of the ſkin, but a cicatrix will form from the edges above and below, leaving a dent where the loſt ſubſtance was..

The ſame thing takes place on the glans penis; an ulcer, which eats a hole on the flat upper ſurface, is repleniſhed; but one on the corona glandis deſtroying the projecting part, with the duplicature of the ſkin on both the ſurfaces, occaſions a loſs which is never reſtored; for the cicatrix commences from the edges of the remaining ſkin, and ſpreads directly over the ulcer.

The ſame circumſtances follow in ulcers or wounds of the lips, ears, and other parts of the ſame kind.

Having ſhewn the ſituations in which, when a part is deſtroyed, there is a growth of new fleſh to occupy the place of that which is loſt, it is requiſite to explain the changes which this new ſubſtance undergoes. And it is proper to remark that in ſimple wounds without loſs of ſubſtance, if there is a cavity formed, there is exactly the ſame growth of new fleſh to repleniſh the cavity that there is when a part is deſtroyed.

The recent appearance and nature of the new fleſh, which fills up cavities, was deſcribed in the firſt ſection. It is, at firſt, tender, uniform in its texture, and extremely vaſcular. The exceſſive vaſcularity, however, gradually leſſens, and the new ſubſtance becomes ſtrong and fibrous.

The moſt natural way I know of explaining this change, is by ſuppoſing that the lymphatics abſorb the ſofter and gelatinous particles, and that the arteries depoſit a conſiderable quantity of the earthy and firmer materials of which the human body is compoſed. The new fleſh continuing thus to be faſhioned by means of the arteries and lymphatics, it is, at length, converted into a fibrous maſs reſembling the cellular membrane.

When this ſubſtance lies between parts which have no motion, the fibrous texture is leſs remarkable, and it is often hard and callous. But when it is ſituated between parts which are naturally moveable, the fibres are more apparent. In this ſituation, as it unites all the parts in cloſe contact, it muſt, at firſt, either prevent, or conſiderably impede the motion; but by degrees the fibres uſually lengthen, ſo that after a certain time, there is generally the ſame, or nearly the ſame, freedom of motion as formerly.

In by far the greater number of caſes of wounds and ulcers, the new ſubſtance, which is formed to obliterate cavities, is of this kind, and continues for life. But this can, with no propriety, be called a reſtoration of the parts which have been deſtroyed; it is only a growth of new fleſh to remedy ſome of the inconveniences which would reſult from a breach of the ſolids. A production of a much more uſeful nature, however, ſometimes takes place. The cuticle and rete-mucoſum, when removed, as was mentioned in the ſecond ſection, are regenerated; and the ſcars of very ſlight wounds and ulcers, after a ſhort time, totally diſappear. Theſe are the only inſtances in which new parts become *preciſely* like the old. But there are ſeveral other parts, which, when deſtroyed, the new ſubſtance aſſimulates to the nature of the old; that is to ſay, where it acquires a conſiderable reſemblance and ſimilar properties, ſo as to be fit for the offices of the old without being entirely alike.

Theſe parts are the ſkin, tendons, ligaments, nerves, mucous membranes, bones, and perhaps ſome others.

Muſcles and glands, however, appear to be a complete exception, and are not capable of ever being renewed. For the cicatrices of muſcular and glandular parts, ſeem only a callous cellular ſubſtance, not endowed with muſcular or glandular powers. What renders it probable that the cicatrix of a muſcle has no contractile power is, that when put into action, it ſwells above and below, but not at the cicatrix. The cicatrix of a gland ſeems ſo different in texture from the gland itſelf, that we may naturally conclude it is not capable of ſecretion. This, however, might be aſcertained by injecting the excretory duct of the gland, and examining whether the injected liquor enters the cicatrix; but hitherto I have not made the experiment.

The manner in which ſkin is produced, has been noticed in a former part of this paper; ſo no more need be ſaid upon that ſubject.

The reſtoration of part of a tendon, or ligament, is by no means uncommon. As the new ſubſtance which grows up in caſes where there is a ſolution of continuity, reſembles the original fibres of theſe parts, very little further change is required. It is only wanted that the new ſubſtance ſhould grow ſtrong enough to be able to ſupport the contraction of the muſcle, or motion of the joint, without laceration; and this, frequently, is effected. The appearance of theſe regenerated parts is different from the original; the fibres are not ſo gliſtening and ſilver coloured, and are not ſo regular in their direction; inſtead of the greater number of them running parellel to each other, there is more confuſion in their arrangement. The new part is, likewiſe, ſomewhat thicker than the old; ſo that there appears a kind of knot where the diviſion was. Notwithſtanding theſe differences, as ſtrength is what is principally required, the new ſubſtance is an excellent ſubſtitute.

The free motion of the part, however, is ſometimes impeded or deſtroyed by the new ſubſtance forming adheſions. Theſe ſometimes occaſion an abſolute immobility; but they generally lengthen by degrees, ſo that the complete motion of the part is finally reſtored. This reſtoration happens with more certainty when the divided extremities are brought into contact, or nearly ſo. Although it ſometimes has occurred even when they were kept at a conſiderable diſtance; and there is a far greater probability of this in caſes of a diviſion of parts only, than where there is ſome loſs of ſubſtance.

Small portions of nerves are ſometimes regenerated; this we know, becauſe when a nerve is cut acroſs, and ſenſation and the power of motion is loſt in the parts to which the nerve goes, both have been obſerved afterwards to return. But this requires a conſiderable time, and happens rarely.

There are frequent inſtances in which mucous membranes, when deſtroyed, are reproduced. Parts of the internal ſurfaces of the urethra, fauces, bronchiæ, and even inteſtines, have been often deſtroyed by ulceration and other means, and the whole has healed, and a new membrane has been afterwards formed, fit for the offices of the old.

Bones, the hardeſt ſubſtance of which the human body is compoſed, are reſtored in a moſt remarkable manner; and this reſtoration takes place not only when there is a ſimple diviſion of the bone, or where part is removed; but there have been inſtances of a new bone being formed, even when the old was entirely taken away: and this happens to the flat broad bones of the head, as well as to the cylindrical bones of the extremities. But it muſt not be imagined that the new bone is exactly like the old. It is very different in its appearance, and generally very irregular in its form. The new oſſification is apt to be much too large, and requires therefore to be confined by the ſurgeon's art. The irregularity of the form, and the luxuriancy of the oſſification generally occaſion an anchyloſis, when the callus is at, or very near a joint.

The new bone is formed exactly by the ſame proceſs that the original bone was formed; that is to ſay, by the arteries oſſifying.

There is one inſtance where a fracture is very ſeldom united by bony matter, but almoſt always by a ligamentous ſubſtance, which is, the fracture of the patella, owing, I ſuſpect, to this circumſtance. The cavity of the fractured patella muſt communicate with the cavity of the joint; the extravaſated blood, therefore, cannot fill up the ſpace between the fractured ſurfaces, as in other fractured bones, but it eſcapes principally into the joint; and the ſynovia inſinuates itſelf between the broken parts. The ſynovia is not, like the blood, a proper medium for veſſels to ſhoot into; conſequently the fractured patella cannot be united as other fractured bones are, by ſoft parts afterwards becoming bony, except in a very few inſtances where the fractured parts are brought ſo cloſely together as to exclude the ſynovia. This, however, is rarely the caſe, for the muſcles uſually pull aſunder the fractured parts in ſuch a manner, as that it is impoſſible to retain them in contact. Although, therefore, the fractured ſurfaces of the bones inflame as in other caſes; and although the adheſive exſudation oſſifies and covers the expoſed cancelli of the fracture, yet as the fractured portions are not in contact, the cavity between the broken bone cannot be filled with living fleſh, becauſe it is occupied by ſynovia.

The uſual mode of uniting fractures, therefore, fails here, and the following takes place: The cellular ſubſtance, which connects the patella to the ſkin, and which, when a fracture occurs, muſt form part of the parietes of the joint, is lacerated by the accident. This inflames as well as the ſurface of the fracture; and all the cells are united by the inflammatory exſudation, ſo as to prevent the ſynovia eſcaping. This forms an union between the fractured bones; it is weak at firſt, but becomes gradually ſtronger, of a ligamentous nature; and at length is able to ſupport, without laceration, the full exertion of all the muſcles that are inſerted into the baſis of the patella.

In the caſes where the new ſubſtance which unites divided parts aſſimulates to the nature of the old, it would naturally be expected, if we judge from what happens to the ſkin, that the change ſhould commence at the original parts; that is to ſay, if a portion of nerve, for example, is to be formed, the nervous power will be given firſt to the new ſubſtance, which is contiguous to the divided portions of the old nerve, and thence extend itſelf. As the progreſs of the reſtoration, probably, advances in this manner, it is evident, that the greater the deſtruction of a part is, there will be the leſs chance of the whole intermediate ſubſtance aſſimulating to the nature of the old; and where there is a ſimple diviſion only, there is a greater probability that the reſtoration will take place than if part had been cut out.

But this does not altogether apply to bone; for although oſſification uſually begins from the original bone, yet, when an entire bone is removed, this cannot occur; but in that caſe, the oſſification commences at many parts at once, by which means this proceſs, from its nature tedious, is finiſhed more quickly.

Having mentioned thoſe parts which when deſtroyed are ſometimes reſtored, I ſhall juſt obſerve, that if we had it in our power to make an election of what parts we would wiſh the body capable of regenerating, and if there were ſome unavoidable neceſſity which prevented the whole from being reſtorable, we ſhould certainly chooſe the very parts which, at preſent, are ſo. Not becauſe they are more important than many others, but becauſe the loſs of them would occaſion an extenſive loſs of other ſound parts, and other inconveniences. The ſimple diviſion of a nerve, for example, if it could not be regenerated, would render all the muſcles and parts uſeleſs to which the nerve branched. The fracture of a bone would occaſion a ſtill greater loſs; and what prodigious inconveniences would reſult from wounds, if cicatrices did not form. But if a piece of muſcle or gland is deſtroyed, when the remaining parts grow together, the loſs is inconſiderable. For the muſcle can, often, continue to act, and the gland to ſecrete, as before. No other loſs being ſuſtained, except ſimply the deprivation of the part which was removed.

Having, at length, given the beſt anſwer in my power to the queſtions propoſed by the Patrons of the Lyceum Medicum Londinenſe, I remain wavering in my mind, whether to lop off ſome of the leaſt material parts of this diſſertation, or ſtill to lengthen it, and render it more minute and circumſtantial.

In this uncertainty I am precluded from conſulting any friend, by whoſe ſuperior and more mature underſtanding I might be determined; for, unleſs the whole compoſition is my own, I muſt forfeit all right to the prize which I aſpire to.

Such as this Paper is, it muſt, therefore, be ſubmitted to the penetrating inſpection of my judges, to whom, even if they decide againſt me, however much my ſelf-love may be mortified, it will be impoſſible for me to refuſe my eſteem.

THE END.

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